MYRTLE BEACH AND VICINITY SHORELINE PROTECTION PROJECT
HORRY AND GEOBGETOWN COUNTIES, SOUTH CAROLINA

FINAL
ENVIRONMENTAL IMPACT STATEMENT

US ARMY CORPS OF ENGINEERS JANUARY 4993
CHARLESTON DISTRICT
SOUTH ATLANTIC DIVISION

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FINAL ENVIRONMENTAL IMPACT STATEMENT

Myrtle Beach and Vicinity Shoreline Protection Project, Horry and Georgetown Counties, South Carolina

RESPONSIBLE AGENCY: The responsible lead agency is the U.S. Army Engineer District, Charleston.

ABSTRACT: Myrtle Beach and vicinity, known as the Grand Strand, is a major recreational and economic resource for the state of South Carolina. The main attraction to the Grand Strand is the coastal beaches. Despite state and local efforts to protect and preserve the beach resources, the problem of protecting existing coastal development from erosion add winter storm tides remains an extreme concern. Many nonstructural and structural alternative plans were evaluated to remedy the problem. The recommended plan involves the construction of 25.4 miles of protection beach on three independent reaches. All nourishment material will comp from offshore borrow areas. These borrow areas are from 1.5 to 5 miles offshore from the beaches to be nourished.

The official closing date for the receipt of comments is 30 days from the date on which the Notice of Availability of this Final EIS appears in the Federal Register.

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1.0 Summary

1.1 General

In response to a resolution by the Committee on Public Works and Transportation of the House of Representatives, United States, adopted 17 November 1981, a feasibility study was conducted to identify problems and needs associated with beach erosion and storm protection along the northeastern coast of South Carolina. The study was completed and a report prepared in October 1987 (revised June 1988). The recommended source of borrow material for initial construction and periodic nourishment was identified in the report in the Canal Industries Waterway and International Paper Waterway site, with additional investigation of offshore sites. Hurricane Hugo struck the South Carolina coast 21 September 1989 causing extensive beach erosion, damage to beach revetment structures, and damage to homes and commercial buildings. The state of South Carolina responded with an emergency nourishment project which involved transporting sand material from various inland and inlet locations to the Grand Strand beaches. Some of the borrow sites used were those planned for the authorized project. In addition to borrow sites, the emergency nourishment also changed beach profiles. The changes in topography and borrow site location required the original pre-Hugo authorized project to be updated. The update, or General Design Memorandum (GDM), includes project design, economic investigations, real estate and environmental requirements. The original report contained an Environmental Assessment which was completed in 1987. The Environmental Impact Statement, contained herein, addresses the entire recommended project, including the borrow sites located offshore. The project was authorized for construction in the 1990 Water Resources Development Act and is published in House Document 101 - 248, 1990.

1.2 Authorized Project

The authorized project galled for construction of a protective beach along the Grand Strand area.

The project recommended for construction herein consists of three roaches. Reach 1 extends for a total distance of 45,466 feet or 8.6 miles. This beach is referred to as Reach 1 or North Myrtle Beach.

Reach 2 extends for a total distance of 49,732 feet or 9.0 miles and is referred to as Reach 2 or Myrtle Beach.

Reach 3 extends for a total distance of 40,658 feet or 7.7 miles and is referred to as Reach 3 or Garden City/Surfside. The total distance of all three reaches is 135,856 feet or 21.4 miles.

This project has three non-Federal sponsors, one for each reach. The non-Federal sponsor for Reach 1 is the City of North Myrtle Beach. The non-Federal sponsor for Reach 2 is the City of Myrtle Beach. Reach 3 lies within the jurisdictional boundaries ok Georgetown County, Horry County, and the Town of Surfside Beach. Horry County has agreed to be the non-Federal sponsor for Reach 3; they plan to enter into a separate agreement with Georgetown County and the Town of Surfside Beach for the cost share of their respective portions.

The recommended project calls for the initial placement of 5.1 million CY of material on the beach. This material will come from offshore borrow sites. There are sufficient quantities of material at these sites for initial construction and all periodic nourishment efforts. Periodic nourishment will take place once every eight or ten years as required. This material will also come from the offshore sites. Sand fencing will be installed at Reach 1 to aid in achieving the design berm height. The new berm will be planted with beach grasses to stabilize the dupe.

1.3 Alternatives

Several alternatives were considered during this study to prevent beach erosion and storm damage to the beaches. Nonstructural alternatives were considered as were a combination of nonstructural and structural measures. None of these plans, including the "No Action Plan", would result in an effective preventive for beach erosion or storm damage reduction. Several structural plans were studied and eliminated from consideration because of economic constraints and in recognition of desires and preferences voiced by state

and local government representatives. Because of the difficulty in locating suitable sources of sand in the study area, a considerable amount of effort was concentrated on locating suitable inland/offshore borrow areas. More than 170 property owners with highest potential reserves were contacted concerning availability of land and permission to explore their property. Of the 170 properties, eight were identified ay potential sources for conducting field investigations. Four upland sates were identified but were eliminated from consideration because they became unavailable. Several studies involving vibracore sampling were conducted to locate suitable offshore borrow areas. Suitable offshore borrow areas have been located and have been recommended for use during construction of this project.

1.4 Environmental Impacts

The recommended plan would provide storm protection for valuable beachfront property and help assure the viability of the Grand Strand's tourist oriented economy through use of methods that will have a negligible adverse impact on the area's fish & wildlife resources. The area's aquatic environment would not be significantly altered. An additional intertidal and high-aide beach area would be created and maintained which would benefit a variety of invertebrates, birds, and fish.

The principle adverse effects of constructing the recommended project are related to the dredging of sand from offshore borrow sites and placement as well as movement of the sand once it is on the beach. Hopper dredging would temporarily increase turbidities in the immediate vicinity of the dredge and in the immediate vicinity of the beach where the material is being placed. The effects from turbidity associated with this project would be temporary and minor. Hopper dredges operate like a large vacuum, which cause only insignificant and temporary turbidity plumes. In addition to a minor increase in turbidity which may temporarily depress water quality, the dredging may destroy benthic organisms which are picked up and pumped to the beach. Placement of sand on tidal and sub tidal beaches will smother some organisms inhabiting the beach. The loss of organisms from the dredging operation at the borrow sites and from smothering on the beach is considered insignificant as these animals will decolonize affected areas very quickly. A monitoring plan is being designed to monitor the effects to near shore, and offshore borrow site benthos. The presence of the dredge and other

construction equipment will be aesthetically displeasing to some people as will the noise from this equipment.

2.0 Need for and Objectives of Action

2.1 Purpose and Need (of the Proposed Action)

The Grand Strand area of South Carolina has become a major recreational and economic resource of the state. Based on the latest information obtained by the South Carolina Department of Parks, Recreation, and Tourism, this area, comprised of Horry and Georgetown Counties, had in excess of 10.6 million visitors in 1991 that created a record breaking total of nearly $2.2 billion in visitor spending and accounted for approximately 43% of the State's total travel-tourism spending.

A major seasonal attraction to the Grand Strand is the coastal beaches which are the basis for the majority of recreational development. Approximately 90 golf courses attract people to the Grand Strand on a year-round basis. Coastal development has proceeded at a rapid pace and now covers practically the entire beach front area. Density has also increased dramatically as single family residences have been replaced by high rise hotels and resort condominiums. The demand for beach access has resulted in an encroachment of development as close as possible to the remaining dune line and in many cases this development has damaged the natural coastal defense system.

The City of Myrtle Beach has completed the second phase of a two-phase nourishment project designed for typical weather and erosion conditions experienced along Myrtle Beach during a one-to-ten year period. The project also resulted in a 45-55 foot wider high-tide beach along the nourished portion within the city limits.

Phase I, placed during the winter months of 1985 and 1986 consisted of the placement of 316,517 cubic yards of fill between 10th Avenue North and 29th Avenue South. Phase II, placed during the winter of 1986 and 1987, added an additional 537,270 cubic yards between 82nd Avenue North and Sunset Terrace; and between 31st Avenue North and 19th Avenue North for a total pay yardage of 253,787 cubic yards. This project placed an average of 19.75 cubic yards of sand per foot of shoreline at an average cost of $109.61 per foot or $5.55 per cubic yard. Total project cost was approximately $4.5 million.

Beach fill way obtained from inland sources and trucked to the front beach where the material was spread using land based equipment. Each truck carried an average of 14.3 cubic yards and during work periods there were an average of 14.34 truck hauls per hour for a total of 59,539 truck loads.

Despite state and local efforts to protect and preserve the beach resources, the problem of protecting existing coastal development from damages due to normal erosion and to abnormal tides, particularly during winter storms and hurricanes still remains. In 1989 Hurricane Hugo struck the South Carolinas coast just north of Charleston. Damages to Horry County including the Grand Strand beaches were estimated at approximately $460 million. The winter storm of 1 and 2 December 1986 resulted in an estimated $2 million in structural damages in the Grand Strand area. This storm was followed by a second storm in January 1987, which, according to figures obtained by the State Office of Emergency Preparedness, damaged 387 homes and 601 businesses along the coast. Damages in the Horry County/ Georgetown County area were estimated to be about $13.3 million.

2.2 Planning Objectives

The "Economic and Environmental Principals and Guidelines for Water and Related Land Resources Implementation Studies" (The Principals and Guidelines, or P&G) are the principle guidelines for planning by Federal agencies involved in water resources development (USWRC, 1983). Although each project and project setting presents unique problems and opportunities, the Corps of Engineers applies a consistent set of decision criteria to participation in project planning and construction. There are three basic criteria: 1. that there is an economically justified and environmentally acceptable project, 2. that Federal participation be otherwise warranted, and 3. that the project means current Administration budget priorities.

The Federal objective, as stated in the P&G, is to contribute to national economic development consistent with protecting the nation's environment, pursuant to national environmental statues, applicable executive orders, and other Federal planning requirements.

Economic justification has been a major consideration in the development of civil works projects since the Flood Control Act of 1936. In this Act, Congress required that the Corps recommend a project only "if the benefits to whomsoever they may accrue are in excess of the estimated costs and if the lives and social security of people are not otherwise adversely affected."

If there is an economically justified project, decision on whether and to what extent there should be Federal participation are guided by a concept of the Federal interest that has evolved from legislation, from precedent in project authorization and construction, and from Administration budget priorities. Federal participation is limited in circumstances where there are special and local benefits which accrue to a number of identifiable beneficiaries. The Federal government does not formulate projects based on benefits which are incidental to basic project purposes. The Administration does not budget for a project unless a significant proportion of the outputs have a high budget priority.

Federal planning concerns other than economic include environmental protection and enhancement, human safety, social well being, and cultural and historic resources. Environmental and safety considerations are of prime importance. In developing project modifications, the Corps:

- Provides for full consideration of measures to protect, enhance and restore ecological, aesthetic, historical and cultural resources;

- Attempts to obtain the best available information on the environmental effects of plans through an exchange of views and information with resource agencies at all levels of government, affected interests and the public;

- Provides equal consideration throughout planning for environmental, economic, social, financial and engineering factors in plan development, evaluation and modification of the authorized project;

- Attempts to minimize adverse environmental effects, including irreversible commitments of resources, and so mitigate unavoidable losses to the extent appropriate, concurrent with project construction.

Participation in shore protection projects is limited to beach restoration and protection, not beach creation or improvement unless such improvement is needed for engineering purposes. In addition, the Federal cost share id reduced proportionately to the extent that a project protects private shores from beach erosion and land loss.

The recommended project is formulated to insure that the project meets the specific needs and concerns of the general public within the project area; responds to expressed public desires and preferences; is flexible in order to accommodate economic, social, and environmental patterns and changing technologies; is integrated with and is complementary to other related programs in the study area; and is implement able with respect to financial and institutional capabilities and public consensus.

2.3 Study Authority and Background

In response to a resolution by the Committee on Public Works and Transportation of the House of Representatives, United States, adopted 17 November 1981, a feasibility study was conducted to identify problems and needs associated with beach erosion and storm protection along the northeastern coast of South Carolina. The study was completed and a report prepared in October 1987 (revised June 1288). The primary source of borrow material for initial construction and periodic nourishment was identified in the report as the Canal Industries Waterway and International Paper Waterway sites, with additional investigation of offshore sites. Hurricane Hugo struck the South Carolina coast 21 September 1989 causing extensive beach erosion, damage to beach revetment structures, homes, and commercial buildings.

The state of South Carolina responded with an emergency nourishment project which involved transporting sand material from various inland and inlet locations to approximately 15 miles of Grand Strand beaches. Some of the borrow sites were those planned for the aphorized project. In addition to borrow sites, the emergency nourishment also changed beach profiles. The new dunes were generally designed with a top elevation of 9.0 feet NGVD and v 15 foot top width. The changes in topography and additional borrow site locations required the pre-Hugo project to be updated. The General Design Memorandum (GDM), which updates the necessary items,

includes project design, economic investigations, real estate, and environmental requirements. The Feasibility report contained an Environmental Assessment which was completed in 1987. This Environmental Impact Statement addresses the entire project, including the new borrow sites located offshore. Toe project was authorized for construction in the 1990 Water Resources Development Act. The authorization was based on the original Feasibility Report and Environmental Assessment.

3.0 Alternatives Considered

3.1 Plans Eliminated From Further Study

As shown in Table 1, all possible alternatives did not meet each established local and Federal planning objectives. The alternatives which best met all objectives were variations of beach fill measures and the stabilization of beaches and dunes by vegetation. However, since the dune system has been destroyed or severely damaged, the stabilization of the dune and beach system by vegetation was not a viable solution. Therefore, only variations of beach fill measures were carried into the intermediate phase of plan formulation.

A combination of nonstructural measures was also carried forward into the intermediate stage of evaluation. These alternatives included rezoning, building code modification, establishment of setback lines, flood insurance, evacuation planning and other similar nonstructural measures. Most of these alternatives have been at least partially implemented by local government and only some refinement is needed. Although these alternatives can decrease the overall storm impact, they do not substantially reduce the vulnerability to damage of existing beaches and structures. Therefore, a nonstructural plan does not fully meet the objectives of this study. From the point of view of the economic evaluation, a nonstructural plan at this location has approximately the same value as the no action plan.

Hard structure plans which included measures such as bulkheads, groins, and offshore breakwaters were eliminated from detailed consideration due to economic constraints and in recognition of desires and preferences voiced by state and local government representatives. Construction of a dune to provide hurricane surge protection was also evaluated. This

would require construction of a dune with a width and height capable of protecting upland property from run up induced flooding and wave attack from storms of hurricane severity. The construction of o 20-year level protection beach fill would provide protection against q hurricane with a surge of approximately 8.8 feet NGVD. However, a project of this size is not justified, nor acceptable to the general public. Protection against larger storms would also be unjustified due to the low elevation of the existing dune system. A hurricane project for a 100-year storm would of necessity have to be constructed along the entire 37-mile study area and the cost of such a project would greatly exceed the benefits. Therefore, during the evaluation of preliminary plans, it was determined that hurricane protection measures for the study area were not justified at the present time.

3.2 Without Conditions (No Action Alternative)

The "no action" alternative would allow the continuation of the erosion and storm damage currently being experienced along the Grand Strand. This alternative would not provide relief from the problems affecting residents and visitors to the Grand Strand and their property. The no action alternative represents the baseline condition and is retained only for comparison with the considered alternatives.

3.3 Plans Considered in Detail

Beach nourishment with periodic nourishment was determined to be the best solution to the problems being experienced in the study area. Four variations of this alternative providing 2,5,10, and 20-year levels of protection were evaluated for each study reach. The volume of sand and berm height and width, and periodic nourishment cycles are the only difference between the four plans. Major damage areas identified for restoration include an 8.6 mile reach in North Myrtle Beach (Reach 1), a 9.0 mile reach in Myrtle Beach (Reach 2), and a 7.7 mile reach in the Garden City/Surfside Beach area (Reach 3).

3.4 Borrow Areas.

Because oz the difficulty of locating suitable sources of sand in the study area, a considerable amount of effort was

concentrated in locating suitable inland and offshore borrow areas. More than 170 property owners with high potential for inland sand reserves were contacted concerning availability of land and permission to explore their properties. The 170 properties were narrowed to four sites [the Canal Industries Waterway site, Bell, International Paper Waterway site, and International Paper 501 site (south parcel only)] which were selected for consideration for project construction. The Canal Industries Waterway site contained more than 10 million cubic yards of sandy dredged material suitable for beach nourishment. This material was placed in a 420 acre strip along the waterway during initial construction and O&M of the AIWW. The Bell site consisted of a sandy area between Carolina Bays which contained about 537,000 cubic yards of sand. Reserves in sand ridges in the International Paper 501 site (south of 501 only) were estimated at more khan 2 million cubic yards. The International Paper (IP) Waterway site was o 326 acre state permitted sand mining area which was used as a source of sand materials for the city of Myrtle Reach nourishments project in 1986 & 4987. Reserves totaled more than 7 million cubic yards of sandy dredged material placed during initial construction and O&M of the AIWW. Because of concerns expressed by state and Federal agencies, it was determined that the most environmentally acceptable sources of sand was the AIWW disposal areas in the Canal Industries Waterway and IP Waterway sites.

In addition to inland sites, several studies of potential offshore borrow areas were conducted. The first study investigated areas up to 5000 feet offshore. Vibracore sampling revealed much of this area to be hard bottom and live bottom not suitable for beach nourishment. The second offshore study included vibracore sampling from about one to three miles offshore. This study revealed that suitable quantities of sand may be present in: a sand ridge off Garden City; surface cover from Little River Inlet to Cherry Grove Beach; buried channels offshore of Canepatch Creek; and located in the delta offshore of Murrells Inlet (See Figure 2).

C third offshore study involved extensive vibracore sampling (every 2,040 feet apart over the entire area) of the same three areas from approximately 1.5 miles offshore to approximately 5 miles. This sampling identified more than adequate sand supplies for initial construction and periodic nourishment for the 50 year economic life of the project. These same three areas were surveyed for live bottom. During

this survey an artificial reef was discovered in the northern most area (surface cover). Because of this reef, the dimensions of this area were shifted south where vibracore sampling indicated an abundance of sand. Live bottom surveys were performed on this new area with no artificial reefs located.

3.5 Recommended Clan

The recommended plan is the most acceptable environmental plan and provides for construction of a protective beach in three separate reaches.

North Myrtle Beach (Reach 1) - Restore about 8.6 miles of beach from Hog Inlet down coast to White Paint Swash near 48th Avenue South with approximately 2.2 million cy of dredged material obtained from the northern most offshore borrow sites (See Figure 2). Periodic nourishment with about 444,000cy of material obtained from the same borrow area will be required every 10 years. The initial berm will be constructed to an elevation of 10.0 feet NGVD with a top width of 20 feet. Side slopes will be 1.0 foot vertical and 20.0 feet horizontal.

Myrtle Beach (Beach 2) - Restore 9.0 miles of beach from Bear Creek Swash near 82nd Avenue North down coast to Midway Swash near 49th Avenue South with approximately 1,830,000 cy of sand obtained from either the Cane North or the Cane South off-shore borrow sites (See Figure 2). Periodic nourishment with about 449,000cy of sand obtained from the same borrow site would be required every eight years, with one 10 year effort requiring 550,000cy. The initial berm would be constructed to an elevation of 9.0 feet NGVD with a top width of 15 feet.

Garden City/Surfside Beach (Reach 3) - Restore 7.7 miles of beach from near Myrtle Beach State Park down coast to approximately 1.2 miles south oz the Georgetown/Horry county line with about 1.1 million cy of sand obtained from the Surfside offshore borrow site (See Figure 2). Periodic nourishment with about 360,000cy of materiel from the same borrow area would be required every eight years, with one 60 year effort requiring 450,000cy. The initial berm would be constructed to an elevation of 7.0 feet NGVD with n top width of 10 feet.

4.0 Affected Environment.

This section describes the environmental components of the project area that would affect, or be affected by, any of the final array of alternatives.

4.1 Physical Environment

A. General

The study area encompasses approximately 37 miles of South Carolina's coastline and its environs from Little River Inlet at the North Carolina-South Carolina border at Murrells Inlet. The area extends oceanward to about 18,200 feet from the shoreline and inland approximately 14 miles near the City of Conway. This straight to gently-curving shoreline bordered by the Atlantic Ocean is oriented in a northeast-southwest direction. On the basis of geomorphology, it is classified as an arcuate strand, characterized by wide, flat beaches and breached by few tidal inlets (Hayes et al. n.d.). Referred to as the Grand Strand, the area includes Little River, North Myrtle Beach (Cherry Grove Beach, Ocean Drive Beach, Crescent Beach, and Windy Hill Beach), Atlantic Beach, Myrtle Beach, Surfside Beach, Garden City, and Murrells Inlet. The study area is located in Horry and Georgetown Counties.

b. Climatology

The climate of the area is temperate and is moderated by the nearness of the ocean and the Gulf Stream. Summers are warm and humid with temperatures of 100 degrees Fahrenheit or higher occurring, on average, less than once a year. The mean annual temperature is about 64 degrees Fahrenheit. The frost-free growing season averages about 231 days. The first freeze generally occurs around the first part op November and the last freeze near the end of March. Precipitation is well distributed throughout the year with an average of about 50 inches. Percentage of precipitation by season is as follows: 18% winter; 20% spring; 41% summer; and 21% fall. Low pressure areas moving northeast along the coast bring heavy amounts of rain but rarely snow during the winter months. During the late summer or fall months, hurricanes occasionally reach the South Carolina coast. Available records indicate that over 70 storms and/or hurricanes have struck the coast. Heavy precipitation usually occurs with these storms.

C. Geology, Soil, Minerals

The project lies along the eastern edge of the Atlantic Coastal Plain Physiographic Province. This province is underlain by sediments of cretaceous to recent age which becomes thicker in a southeasterly direction from the fall line. The materials forming the beaches in the project area consist chiefly of silica sand. On most beaches, a thin bed of peaty clay or sand crops out near mean sea level. This layer is commonly covered except immediately after storms and is more resistant to erosion than the beach sands. Soils in the Myrtle Beach and vicinity commonly belong to the Capers and Wando coastal beach association.

Native beach sand characteristics were determined from grab samples taken from 33 profile lines 8000 linear feet apart along the length of the project. These samples were taken near the surface and at locations of the edge of dune (EOD), +2.8 NGVD, 0.0 QGVD, -2.3 NGVD, -6.0 NGVD, -12.0 NGVD, -18.0 NGVD, and -24.0 NGVD for each profile line. Reach 1 and Reach 2 each had a total of 96 samples while Reach 3 had 72 total samples. The District compared the native beach materials with that of the potential borrow site material for grain size and composition compatibility. These samples were analyzed using standard sieve sized 1/2, 1/8, 4, 7, 10, 24, 18, 25, 35, 45, 60, 80, 120, 170, and 230.

1. Native Beach Materials The native sand sampled on the beach and near shore of Forth Myrtle Beach, Myrtle Beach, and Garden City and Surfside Beaches varied from fine sand size classification to medium sand size classification in both the Unified Soil Classification System and the Wentworth Classification System. In North Myrtle Beach the mean grain size for the beach samples varied from 0.16 mm (2.64 phi) to 1.08 mm (-0.11 phi) with a composite mean grain size of 0.263 mm (1.93 phi). The mean grain size for the near shore samples varies from 0.11 mm (3.18 phi) to 0.59 my (0.76 phi) with a composite mean of 0.209 mm (2.23 phi). The composite mean for both the beach sand samples and the near shore sand samples was 0.235 mm (2.09 phi). Of the 48 near shore sand samples, eight were not used in the composite. These samples did not appear to be representative due to their large shell content. Of the 48 beach samples, more than 62% had less than 1% visual shell content, and the maximum shell content for a single sample was 21%.

Myrtle Beach grain size varied from 0.20 mm (2.31 phi) to 0.89 mm (0.17 phi) for beach sand samples. The composite mean grain size was 0.44 mm (1.18 phi). The mean grain size for the near shore sample was 0.16 mm (5.64 phi) to 1.78 mm (-0.83 phi) with a composite mean of 0.50 mm (1.00 phi). The composite mean for both the beach sand samples and the near shore sand samples was 0.47 mm (1.09 phi). Of the 48 near shore sand samples taken, 12 were not used in the composite. These samples did not appear to be representative because of their excessive shell content. From the 48 beach sand samples, more than 37% of the samples contained less than 1% visual shell content. The maximum amount of shell content for a single sample was 14%.

The mean grain size of beach sand sampled at Garden City and Surfside Beaches varied from 0.18 mp (2.47 phi) to 1.14 mm (-0.19 phi). The composite mean grain size was 0.44 mm (1.21 phi). The mean grain size for the near shore sample varied from 0.16 mm (2.64 phi) to 1.54 mm (-0.42 phi) with a composite mean of 6.41 mm (1.29 phi). The composite mean for the beach sand samples and the near shore samples were not used in the composite due to excessive shell content. Of the 33 beach sand samples considered, 30% contained less than 1% visual shell content. The maximum amount of shell observed for any one sample was 21%.

The wide range of sorting values for both the beach and near shore sand samples indicate that the material placed on the beaches after Hurricane Hugo has yet to become fully sorted. For North Myrtle Beach the composite sorting value for the beach sand samples was 0.52 and the composite sorting value for both the beach and the near shore sand samples was 0.55. Myrtle Beach had a composite sorting value for the beach sand samples of 0.96 while the combined composite sorting value for the beach sand samples and the near shore sand samples was 0.98. The composite sorting value for tae beach sand samples at Garden City and Surfside Beaches was 0.88 with a combined sorting value for the beach near shore sand samples of 0.83. The varied range of grain sizes from one section of beach to another could also be explained by this. North Myrtle Beach was nourished by material from Hog Inlet; while the material which nourished Myrtle Beach came from inland borrow sites. Garden City and Surfside Beaches were nourished from the deposition basin adjacent to the up-coast side of the jetty at Murrells Inlet.

d. Littoral Drift

When waves approaching the shoreline at an angle are not completely refracted, the breaking waves create a long shore of littoral current. This current is more apparent in the surf or breaker zone than farther out. It carries the beach sand, which has been stirred into suspension by the turbulence of the breaking waves, along the shore parallel to the beach. The sand, which is moved in this way, is known as littoral drift. The term "net littoral drift" refers to the difference between the volume of sand moving in one direction among a beach and that moving in the opposite direction. At Myrtle Beach and adjacent beaches, this directional movement appears to be balanced. Shoreline changes in the vicinity of Myrtle Beach have averaged approximately one foot lost per year during the last half of this century and are due primarily to storm damage erosion and a rising sea level.

e. Water Resources

There are three geologic formations in the area which serve as ground water aquifers, the Tuscaloosa, Black Creek, and Peedee (Cooke, 1936). Most of the well water along the Grand Strand comes from the Black Creek and Peedee formations. The Black Creek formation consists chiefly of dark-gray laminated clay and sand. Water drawn from this formation is soft, highly mineralized, and contains considerable sodium bicarbonate. Many flowing wells in Georgetown and Horry Counties draw their water from this formation. The Peedee formation consists of gray sandy marl inter-bedded with thin ledges of marlstone. Waters in this formation are soft and contain considerable sodium bicarbonate. The Tuscaloosa formation contains a great deal of sand through which water can circulate freely and as a result is one of the most productive water bearing formations in the Coastal Plain. Water derived from the Tuscaloosa formation is soft and only moderately mineralized.

f. Tides

At Myrtle Beach, the mean tide range is 5.1 to 5.3 feet and the spring range is 5.3 to 5.9 feet (the spring tide is the tide which rises highest and falls lowest when the earth, sun and moon are aligned). Some of the highest observed storm tides in the area were produced by Hurricane Hazel on 15 October 1954. At Cherry Grove Beach, a maximum high-water mark of nearly 17.0 feet above NGVD was observed.

g. Water Quality

Ocean waters in the study area are generally considered to be of high quality and are used for numerous water oriented activities such as swimming and fishing. Salinity is very close to that of the open ocean due to a general lack of freshwater inflow.

4.2 Biological Resources.

a. Vegetation and Wildlife

Fs a result of extensive development, the primary terrestrial habitat in the immediate study area consists of urban and built-up lands, such as residential, commercial, industrial, and transportation, communication, and utility corridor areas. Vegetative cover in the area varies from sparse remnants of previous vegetation in areas that have been severely altered to a more natural condition in areas where developers recognized the importance of maintaining areas of undeveloped open space. Many species are displaced when development occurs while other, more gregarious species continue to prosper in suitable habitat in and along the edges of developed areas. Other habitats in the study area include the beach and near shore ocean, dunes, shrub thickets, and forested areas.

In most areas along the South Carolina coast, beaches are gently sloping transitional areas between open water and upland communities. These communities typically consist of a dry berm zone located beyond the high tide zone, an intertidal zone that is alternately covered and exposed by tidal action, and a sub-tidal zone that occurs below the low tide line and extends seaward. In the study area, the dry beach berm has generally been severely eroded and the intertidal areas are narrower and steeper due to the extensive development and erosion control activities which have occurred all along the Grand Strand. Patchy areas of near shore and live bottom habitat occur in the sub-tidal zone (Van Dolah and Knotts 1984) throughout the length oh the project area. Hard ground was more prevalent in the area between Garden City and Myrtle Beach than at other areas of the project.

Relatively few species inhabit sandy beaches, but of those that are present many frequently occur in large numbers. Typical inhabitants are beach fleas (Orchestia

agilis) and ghost crabs (Ocypode albicans) in the beach berm; coquina (Donax variabilis), mole crabs (Emerity talpoidea), amphipods and various burrowing worms in the beach intertidal zone; and blue crabs, horse-shoe crabs, sand dollars, and a variety of clams and gastropod mollusks in the beach sub-tidal areas. In addition, many species of fish commonly occur in the surf zone and deeper near shore waters. The Atlantic silverside (Menidia menidia), bay anchovy (Anchoa mitchili), spot (Leiostomus xanthurus), bluefish (Pomatomus saltatrix), mullet (Mugil cephalus), king fish (Menticirrhus saxatilis), red drum (Sciaenops ocellaqa), flounder (Paralichtys sp.), and seatrout (Cynoscion nebulosus) are the most common. Although the beach zone is utilized by many species of wading and shore birds along much of the South Carolina coast, much of the project area provides somewhat less than ideal habitat for these species because of extensive development, heavy public use, and severe erosion problems.

Much of the dune system is totally lacking in many areas along the Grand Strand due to the extensive development. Few plant species can tolerate the harsh dune environment of sediment instability, salt spray, and periodic salt water over wash. As a result, vegetative cover generally consists of perennial grasses such as sea pats (Uniola paniculata), and other salt tolerant grasses. Because of a general lack of vegetative cover, wildlife usage is limited to small birds, ghost crabs, reptiles and amphibians, and insects.

Offshore borrow sites.

The offshore ocean borrow sites are sub-tidal and defined by two distinct bottom characteristics; hard bottom and sand bottom. Animals commonly found on the near beach ocean bottom ace: sponges, corals, hydroids, bryozoans and ascidians as well as certain anemones, sessile polychaetes, and some arthropods. Most of these animals require hard substratum for attachment. Polychaetes, amphipods, oligochaetes, pelecypods, and decapods represent, among other taxa, the major infaunal assemblages inhabiting sand bottom.

b. Threatened and Endangered Species

In a 24 September, 1991 letter, the Fish and Wildlife Service (FWS) advised that the following threatened and endangered species may be present in the study area:

Listed Species	Scientific Name	Status
Bald eagle	Haliaeetus leucocephalus	E
Red-cockaded wood-pecker	Picoides borealis	E
Wood stork	Mycteria americana	E
Piping plover	Charadrius melodus	T
Arctic peregrine falcon	Falco peregrinus tundrius	T
Loggerhead sea turtle	Caretta caretta	T
Shortnose sturgeon	Acipenser brevirostrum	E
Canby's dropwort	Oxypolis canbyi	E
Pondberry	Lindera melissifolia	E
Cooley's meadowrue	Thalictrum cooleyi	E
Rough-leaved loose-strife	Lysimachia asperulaefolia	E
Sea-beach pigweed	Amaranthus pumilus	SR
Carolina grass-of-parnassus	Parnassia caroliniana	SR
Awned meadowbeauty	Rhexia aristosa	SR
Vahl's fimbry	Fimbristylis perpusilla	SR
Godfrey's sandwort	Minuartia godfreyi	SR
Carolina grass-of-parnassus	Parnassia caroliniana	SR
Chaff-seed	Schwalbea americana	SR

LEGEND

E = Endangered
T = Threatened
SR = Status Reviews

In September 1181, the National Marine Fisheries Service (NMFS) provided the following information on threatened and endangered species which may occur in the area.

Listed Species	Scientific Name	Status
finback whale	Balaenoptera physalus	E
humpback whale	Megaptera novaeangliae	E
Right whale	Eubaleana glacialis	E
Sei whale	Balaenoptera borealis	E
Sperm whale	Physeter catodon	E
Green sea turtle	Chelonia mydas	T
Hawksbill sea turtle	Eretmochelys imbricata	E

Kemp's (Atlantic) Ridley sea turtle	Lepidochelys kempii	E
Leatherback sea turtle	Dermochelys coriacea	E
Loggerhead sea turtle	Caretta caretta	T
Shortnose sturgeon	Acipenser brevirostrum	E

4.9 Human Resources

The evaluation of existing and future socioeconomic conditions in the Myrtle Beach Project area is based on land use plans, demographic conditions, economic base conditions, tourism and recreation, and infrastructure. The project includes areas within Horry and Georgetown Counties.

a. Land Use

In 1987, there were 1,177 farms in Horry County. Farm land made up 24.0 percent of the total land area in Horry County. In 1987, there were 224 farms in Georgetown County. Farm land made up 7.2 percent of the total land area in Georgetown County. Forest land made up 62.0 percent of the total land area in Horry County and 73.2 percent of the total land area in Georgetown County. Horry County contains 15,249 acres of state and Federal owned land, 2.1 percent of the total land area. Georgetown County contains 38,435 acres of state and Federal owned land, 7.3 percent of the total land area.

b. Demographics

The total population of Horry County in 1990 was 144,053 inhabitants. This represents a 42 percent increase since 1980. Horry County ranked first in annual average population growth of all counties in South Carolina from 1980 through 1990. The total population of Georgetown County in 1990 was 46,302 inhabitants. This represents a 9 percent increase since 1980.

Table 2
Population of Incorporated Places
Within the Study Area

Place	1990 Population

Myrtle Beach City	24,848
North Myrtle Beach City	8,636
Atlantic Beach Town	446
Briarcliffe Acres Town	552
Surfside Beach Town	3,845

c. Economic Base and Income

Income. In 1989 the per capita income in Horry County was $12,122. In Georgetown County the per capita income was $11,191. In 1991 the median family income in Horry County was $29,100. In Georgetown County the median family income was $31,600.

Table 3
Per Capita Income and Median Family Income
of Incorporated Places within the Study Area

Place	1989 Per Capita Income	1979 Median Family Income
Myrtle Beach City	$11,067	$16,904
North Myrtle Beach City	12,290	18,496
Atlantic Beach Town	5,314	9,063
Briarcliffe Acres Town	22,347	28,182
Surfside Beach Town	11,555	19,542

d. Housing

The number of housing units in Horry County increased from 29,109 units in 1970 to 89,960 units in 1990, an increase of 299 percent. The number of housing units in Georgetown County increased from 10,813 units in 1970 to 21,134 units in 1990, an increase of 95.4 percent. The median value of homes in Horry County increased form $42,900 in 1980 to $75,600 in 1990, an increase of 76.2 percent. In Georgetown County the median value of homes rose from $36,000 in 1980 to $63,800 in 1990, an increase of 77.2 percent. In 1990 there were 17,566 rented occupied units in Horry County. The median rent was $350 per month. In 1990 there were 3,354 renter occupied units in Georgetown County. The median rent was $232 per month.

e. Employment

In 5990 the civilian labor force in Horry County was 73,880, an increase of 1.8 percent from 1989. In 1990 the civilian labor force in Georgetown County was 22,880, an increase of 5.8 percent from 1989.

Table 4
1989 Employment by Sector for
Horry and Georgetown Counties

Sector	Horry County	Georgetown County
Agriculture	259	238
Mining	E	A
Construction	3,758	655
Manufacturing	6,670	5,263
Transportation and Other Public Utilities	1,517	445
Wholesale	1,840	305
Retail Trade	17,592	3,785
Finance, Insurance, and Real Estate	4,077	607
Services	15,712	2,367
Unclassified Establishments	E	C

A: 0 - 19 employees.
B: 20 - 99 employees.
C: 100 - 249 employees.
D: 250 - 499 employees.
E: 500 - 999 employees.

f. Tourism

Tourism is the main industry in the Grand Strand area. In 1991, tourism generated $6.1 billion throughout the Grand Strand. Area attractions include the beach, golf courses, amusement parks, shopping malls, fishing piers, charter boats, restaurants, and festivals, such as the Sun Fun Festival and Canadian - American Days.

The 90 golf courses in the area alone generated $350 million. Surveys showed the average party of four visiting the area for the Sun Fun Festival spent $260 per day.

The total tourism-generated expenditures can be broken down as follows:

Food Expenditures	31.1%
Transportation Eopenditures	29.4%
Lodging Expenditures	21.2%
Retail Expenditures	10.9%
Entertainment Expenditures	7.4%

The accommodations tax money collected in Sorry County in 1991 was $6,415,997, an increase of 16.1 percent from 1990. Georgetown County collected $356,910 in 7991, a decrease of 2.8 percent from 1980. In Horry County the net revenue received from accommodations tax in 1091 was $5,527,686, an increase of 17.4 percent. In Georgetown County the net revenue received from accommodations tax in 1991 was $380,037, a decrease of 2.1 percent from 1990.

Table 5
Economic Impact of Travel on Horry and Georgetown Counties, 1988

	Horry County	Georgetown County
Total Travel Expenditures (in thousands)	$1,587,257	$73,056
Travel-Generated Payroll (in thousands)	$308,205	$13,696
Travel-Generated Employment (jobs)	36,389	1,647
State Tax Receipt (in thousands)	$91,523	$4,243
Local Tax Receipts		

(in thous.)	$18,724	$621

The Myrtle Beach State Park is located in Horry County. In 1990 there were 1,100,218 total visits to the state park. This ranks above all other state parks in South Carolina.

g. Infrastructure.

Horry County contains 342.80 miles of state primary system highways and 974.12 miles of state secondary system highways. Georgetown County contains 146.83 miles of state primary system highways and 499.78 miles of state secondary system highways.

Within Horry County there are three airports. There is a basic transport airport in the town of North Myrtle Beach, an air carrier airport in the Myrtle Beach area, and a military airport. The military airport has been selected for closure in 1993 in response to the Base realignment and closure act. This base will be available after closure for alternate uses by either Horry County or the City of Myrtle Beach.

4.4 Cultural Resources

A survey using underwater video and side scan sonar of the affected ocean bottom sites has been completed.* The survey was completed by simultaneously towing a side scan sonar system and a television camera mounted on a sled. The tows were spaced 200 meters apart over the entire areas of each offshore borrow site. All five borrow areas surveyed contain a few hard targets which may be non-natural.

* Stender, Bruce W.; Van Dolah, Robert F.; Maier, Phillip; 1791. Identification and Location of Live Bottom Habitats in Five Potential Borrow Sites of Myrtle Beach, SC. Marine Resources Division; South Carolina Wildlife and Marine Resources Department, Charleston, SC.

5.0 Environmental and Socioeconomic Consequences

5.1 Physical Environment

a. Air Quality

Air pollution derived from the dredge and other construction equipment should re negligible during both initial construction and periodic nourishment of the project. It is reasonable to assume that any impacts would be localized and of relatively short duration. Coastal winds prevent the buildup of automobile, boat, industrial and construction produced air pollutants.

b. Noise

Operating dredges are generally quiet and contribute less to ambient noise levels than normal motor and speed boat traffic. Offshore pumps are not expected to impact the ambient noise level as they will be far enough removed from the beach to be heard. Bulldozers will be working on the beach around the clock and may impact adversely the ambient noise level. The bulldozers will be muffled and impacts will be restricted to the immediate construction beach.

c. Water Quality

There will be short-term adverse water quality impacts during the construction period of this project. Dredging the proposed borrow areas will generate turbidity and sedimentation impacts within the immediate vicinity of the okeration1, but the generally large grain size of the material will keep toe area of impact small and will ensure that there are no impacts beyond the period of construction.2 The period of construction will be approximately 12 months each for the three nourishment reaches. Similar short-term water quality impacts will occur at the deposition sites along the 26-yile project shore. Fill operations will deliver slurry of sand to the receiving shore, increasing turbidity in the immediate area. This effect, however, will not be significant since turbidity levels in the high-energy surf area are naturally high. Depths below the existing grade at the borrow sites will average less than the feet. Because of this, there is not expected to be any long term decrease in water quality at these sites. Periodic beach nourishment, which is expected to be required every 8 or 10 years, will have water quality impacts similar to those for initial construction. A 401 Water Quality

Certification has been received from the South Carolina Department of Health and Environmental Control.

5.2. Biological Resources

a. Fish and Wildlife

The effects of the beach nourishment project on population levels of the coquina clam, mole crabs, and other invertebrate species inhabiting the beach intertidal zone will result in temporary adverse impacts to these organisms. These animals are important members of the food chain because they are preyed upon by a variety of commercially and recreationally important fish species and shore birds.

During preparation of the feasibility report for storm damage reduction at Myrtle Beach and vicinity (1983), the U.S. Fish & Wildlife Service provided an accompanying Coordination Act Report (CAR). This CAR dealt primarily with effects to fish and wildlife inhabiting proposed upland borrow sites. Since upland borrow sites are no longer being considered for beach nourishment, most of the service concerns are no longer applicable. However, a concern which did not involve upland borrow sites was the incorporation of a biological monitoring program into the recommended plan to determine the long-term impacts of beach nourishment on benthic populations and the significance of both short-term and long-term reductions in benthic productivity on fish and wildlife populations in the project area. It was the District's position in 1987 and continues to be, that inclusion of a costly long-term program to monitor impacts to benthos inhabiting the intertidal beach area proposed for nourishment would not be a sound investment of local and Federal funds. Since animals of high energy beaches are continually subjected to the effects of erosion and accretion and major physical changes resulting from storms and hurricanes, which in many cases are much more severe and widespread than the effects of the proposed nourishment project, beach nourishment and periodic nourishments would not unduly stress beach and intertidal fauna beyond their adaptive capabilities. Published accounts of the effects of beach nourishment with sandy materials support the conclusion that adverse affects are generally short-term in nature, and the Corps believes the results of the monitoring program being conducted for the Myrtle Beach project support this conclusion. In addition, it must be recognized that beaches in much of the study area have been eroded to the point that they provide less

than ideal habitat for many of the species of concern. This condition will likely persist or become much worse before project construction is initiated. As a result, we feel that the long-term benefits to be derived from providing a more stable beach environment far outweigh short-term adverse impacts which may result from placement of nourishment materials.

This does not mean however, that the District would not support a monitoring plan for near shore and offshore borrow sites. A plan is currently being developed for consideration.

The proposed sandfill operation of the project beaches will cover an area of the shore and near shore. The fill will extend to a maximum of approximately 3 feet below NGVD with a deposit of sand for the entire 25.4-mile project length. Approximately one-third of this area of beach fill will be raised from tidal or sub-tidal elevations to above the level of mean high water. The tidal zone will be displaced offshore from its present location and will experience no net loss in total area. In some areas of Myrtle Beach where there is little or no existing beach at high tide, the project will provide an increase in high tide beach area as the tidal zone is pushed offshore from the face of sea walls to a more gradual sandy beach slope. Much of the increase in beach and beach slope will result in a net loss of shallow near shore (Littoral) zone.

The loss of (Littoral) zone area will mean a direct reduction in habitat for benthic marine invertebrates. This loss is negligible in view of the vast amount of existing near shore area available. The loss of benthic marine invertebrates which currently inhabit the near shore will be a short-term impact, since the new sand bottom will begin to be colonized shortly after construction ceases and re-colonization should be complete within three-to-six months following beach nourishment. Tidal zone species will save an area of habitat equivalent to that at present. Nourishment materials will be clean sand having a grain size similar to that of the existing beach and should be rapidly re-colonized following completion of initial nourishment and periodic nourishment. Since animals associated with high energy beaches are continually subjected to effects of erosion end accretion and major physical changes resulting from storms and hurricanes, initial construction and periodic nourishment will not unduly stress beach and intertidal animals beyond their adaptive capabilities.

There is no anticipated adverse affect on shore birds which loaf and feed on the beach. In fact the beach, after initial construction, may be enhanced for shore bird use. Loss of benthos and epibenthos associated with sandy ocean bottom will be the most direct impact in the borrow areas for this project. Some mortality will occur as organisms pass through the hopper dredge and pumping plants or as a result of being placed in the beach environment. Undoubtedly some benthic organisms, especially sessile species, will be buried by suspended and deposited sandy sediments. This effect is expected to be minimal because hopper dredges, which operate like a large vacuum, do not suspend material into the water column in significant amounts. Due to the rich diversity and abundance of invertebrates and fishes associated with live bottom, considerable effort has been made to identify the nature and extent of these areas. Television and side scan sonar equipment were used in surveys conducted in 1991 - 92 to document characteristics and identify the location and extent of bottom communities within the borrow sites.* Sufficient sand deposits are available in the offshore sites to completely avoid hard bottom communities and still construct and maintain the project beaches. Avoidance of these areas is part of the construction plan. In addition to avoidance of the hard bottom areas, a monitoring plan to collect quantitative data on both the benthic and epibenthic biomass within the offshore borrow areas will record their recovery following dredging. Since the water quality conditions and bottom substrate in the borrow sites will not be significantly altered from those at present, there should be no serious impediment to the recovery of the bottom fauna. The depth of furrows left in the bottom by the hopper dredge drag head will be determined by dredge speed, bottom conditions, etc. but is not expected to exceed two feet.

The project will have no serious direct impact on marine fisheries. Some bottom fishes may be entrained in the intake stream if the hopper dredge, but most fishes are active swimmers and can avoid areas of disturbance. There will be little impact to fish eggs and larvae because the dredge areas are not sites where these life stages are concentrated. The impact to fisheries will be due to the reduced forage base within the borrow area immediately following construction as a result of the destruction of benthos and epibenthos. Because benthic and epibenthic recovery is expected to be rapid following project completion, this impact to fisheries is anticipated to be short-term. There is some evidence do show that the creation of borrow furrows may actually enhance fisheries by attracting fish to these areas of changed bottom

contours, a situation that may be related to the "edge" effect, or ecotones. Sampling for benthic and epibenthic recovery and water quality parameters will help monitor project impacts and may assist with predicting impacts to shrimp, crabs, etc. which may be attracted to the areas of damaged bottom contours.

* Stender, Bruce W., et. al., 1991. Identification and Location of Live Bottom Habitats in Five Potential Borrow Sites Off Myrtle Beach, SC: Report to U S Fish and Wildlife Service, Marine Resources Department Charleston, SC.

b. Threatened and Endangered Species

Coordination with the National Marine Fisheries Service and the Fish and Wildlife Service revealed that their primary concern relates to the effects of the proposed project on loggerhead sea turtle nesting habitat. A Biological Opinion Prepared by the U.S. Fish and Wildlife Service in accordance with Section 7 of the Endangered Species Act states that construction during the nesting season can cause harassment and disturbance so nesting turtles. It further states that nesting activity in the project vicinity is low and that nest surveys, which would be required if construction occurs during the nesting season, would reduce the likelihood of nest destruction. The project plan is to implement nest surveys and relocation plans. The nest survey and relocation activities will begin 65 days prior to beach construction activities, if construction occurs during the nesting season. Nest surveys and relocations will be conducted by personnel trained in nest survey and relocation procedures, and with a valid South Carolina Wildlife and Marine Resources Department (SCWMRD) permit. Nests also will be relocated between sunrise and 10 AM each day, and the relocation will be to a nearby self-release beach hatchery or other save beach location where artificial lighting will not conflict with hatchling orientation. Also, the project construction plans and specification will provide for plowing of the beach after construction (if compacted), to a depth of 36 inches and to level sand escarpment etc. to facilitate nesting. The service recommended that "night time lighting on the dredge should be minimized". This and other construction recommendations will be written into the contracting specifications. It is the opinion of the service that if these provisions are provided, then the project would

not likely jeopardize the continued existence of the loggerhead sea turtle.

c. Other Environmental Factors

There are no wildlife preserves, important agricultural lands, wild and scenic rivers, natural land marks, recognized scenic areas, or any other environments of special interest with the exception of Hurl Rock located where it could be impacted by the proposed project. Hurl Rock, a limestone outcropping at the same elevation as the beach, will be covered over with sand. This project will not involve any hazardous or toxic waste. This project is consistent, to the maximum extent practicable, with the South Carolina Coastal Zone Management Program and the South Carolina Coastal Council has concurred that the proposed activities are consistent.

5.3 Effects of the Project on Human Resources

The beach nourishment project will impact Horry and Georgetown Counties in a positive manner. Without the project, tourism could be expected to decrease or remain the same due to the lack of an adequate beach front. Therefore, travel-generated expenditures and employment could be expected to be stagnant. However, the project will allow Horry and Georgetown Counties to continue growth in these areas at the current rates. In short, the project will allow Horry and Georgetown Counties to progress at the status quo rates.

a. Recreation

The proposed project will significantly improve opportunities for recreational beach use. Where beaches now are narrow or nonexistent, a usable recreational beach 50 - 100 feet wide will stretch 25.4 miles along the project shore. This will draw additional visitors to the South Carolina shore. Recreational fishing, sunbathing and swimming will be temporarily affected by the project since the public, including fishermen, will not be allowed to enter active work areas. However, since the project will be constructed in sections and only those sections actually under construction will be closed to the public, impacts to these activities will be localized and relatively short-lived.

b. Aesthetics

Visual and aesthetic features include the Atlantic Ocean and a narrow beach along much of the project length. There is very little evidence of a dune system along the project length. Man made bulkhead and riprap form the landward side of the nourishment zone for much of the project length especially at Myrtle Beach. A slight increase in the berm height will not reduce the ocean view. Conversely, the nourishment project will provide an attractive and usable all-tide beach. Temporary degradation of aesthetics will occur on the beach during sand placement and movement.

5.4 Cultural

Reference Section 4.4; Hard targets identified during remote surveys of bottom characteristics within the offshore borrow sites will be avoided during initial construction and periodic nourishment operations. The South Carolina Department of Archives and History has concurred with the opinion that avoidance of these hard target areas is an effective way to avoid any effects to properties that might meet National Register criteria. There are no Historical or Archaeological features within the beach nourishment zone which would be affected by the placement and movement of sand.

6.0 Any Probable Adverse Effects Which Cannot Be Avoided

The principle adverse effects of constructing the recommended project are related to the dredging of sand from offshore borrow sites and placement as well as movement of the sand once it is on the beach. The hopper dredging would temporarily increase turbidity in the immediate vicinity of the dredge and in the immediate vicinity of the beach where the material is being pumped. The effects from turbidity associated with this project would be minor because hopper dredging, which operates like a large vacuum, does not cause significant turbidity plumes. In addition to a minor increase in turbidity, which could temporarily affect the water quality, the dredging may destroy benthic organisms picked up and pumped to the beach. Placement of sand on tidal and sub-tidal beach would smother some beach inhabitants. The presence of the dredge and other construction equipment will be aesthetically displeasing to some people as will the noise from this equipment.

7.0 The Relationship Between Local Short-term Uses of Man's Environment and the Maintenance and Enhancement of Long-term Productivity.

The recommended project would serve both the short-term and long-term interests of the local economy by providing immediate and continuing relief from continual damage to the beaches and by enhancing the economic growth of the area by attracting additional tourism and beach related commerce to the area.

8.0 Any Irreversible and Irretrievable Commitment of Resources Which Would Be Involved in the Proposed Action Should It Be Implemented.

The project would not cause any known significant curtailment of the diversity and range of beneficial uses of the local environment. The labor, fuel, and material associated with construction would be irreversible and irretrievably committed.

9.0 Comments and Responses

COUNTY

Georgetown County

COMMENT (1): Several times the report lists Hurricane Hugo as striking in 1987. The correct date is 1989.

RVSPONSE: The indicated corrections have been made in the final EIS.

COMMEYT (2): Page 15 4.1 a - General - The last sentence indicates the study area is in Harry County. About one half of Garden City is in Georgetown County.

RESPONCE: Noted. Georgetown County is included in text.

State

South Carolina Wildlife and Marine Resources (SCWMRD)

COMMENT (1): The DEIS recognizes existing live bottom communities in the vicinity of offshore borrow sites, and states that these areas can be completely avoided during borrow activities. The current document lacks specifics on methods to be used in avoiding live bottom habitats. Given the sensitivity of live bottom habitats and the level of accuracy associated with dredging operations, we feel it necessary to maintain buffer areas around live bottom communities. Buffers of at least 200 meters should be maintained between dredging operations and identified live bottoms. Where feasible, a 500 meter buffer would be preferable.

RESPONSE: Areas of dive bottom habitat were identified in a side scan and video survey conducted by SCWMRD during 1992. The identified live bottom areas will be shown on the contract dredging drawings. The dredging industry has sophisticated electronic positioning equipment to accurately locate and avoid these areas with an established 220 meter buffer zone.

COMMENT (2): We also feel that the environmental review for this project should consider changes in live bottom communities, including monitoring prior to future renourishment projects to revalidate the presence or absence of these communities.

RESPONSE: Future periodic nourishment will consider location of live bottoms, depth of suitable material, grain size of material, and location of borrow sites to nourishment area(s). Additionally, a monitoring plan is being developed with SGWMRD to assess the changes and impacts to the sandy borrow sites.

COMMENK (3): Live bottom communities have also been identified in the near shore zone off Myrtle Beach. There is no evidence that impacts to the near shore hard bottom habitats will be short-term. In fact, our department would expect just the opposite, at least during the 50 year project period. Potential impacts to these resources as a result of beach nourishment and subsequent sand migration are not addressed in

the DEIS. We recommend that near shore live bottom habitats be mapped and a program developed to monitor the movement of discharged materials and its impact on these communities. This information will be essential in the environmental review of future renourishment projects in this area.

RESPONSE: In general, patchy areas of near shore hard and live bottom habitat in the project area was identified by Van Dolah and Knott in 1981 in a report entitled "A Biological Assessment of Beach and Near shore Areas Along the South Carolina Grand Strand". The bulk of the hard bottom habitat is located in the Myrtle Beach reach. The scattered areas of hard bottom areas located in water 5.5 NGVD or less is subject to direct fill by sand. A monitoring plan is being developed with the S.C. Wildlife and Marine Resources Department (SCWMRD) to assess the secondary impacts of sand movement on near shore hard bottom areas en water depths greater than 5.5 NGVD.

COMMENT (4): The recovery rate of benthic communities needs to be fully documented, especially since several previous studies have documented relatively, long-term impacts at these sites on other areas of the region. The DEIS indicates that benthic recovery rates will be monitored, but the document should not suggest that impacts will probably be minimal. In fact, impacts on the benthic resources will probably be significant since these communities are largely restricted to the upper 15-20 cm of bottom sediments. Although it is likely that the proposed dredging method will only result in short-term impacts, the effects should be monitored to ensure that this is the case.

RESPONSE: An extensive review of the literature of other beach renourishment projects have shown that benthic communities recover quickly.8,9 However, a plan is being developed to monitor the recovery rate of benthic communities by SCWMRD staff for at least the initial renourishment effort at Myrtle Beach.

COMMENT (5): The review of impacts to threatened and endangered species in the current document is limited to nesting sea turtles. Sea turtles are present in offshore waters proposed for dredging and the potential exists for mortality or turtles as a result of entrainment during hopper dredge operations. For this reason, we feel attention to this issue is warranted. Dredging operations should be monitored to avoid negative impacts to turtles and to ensure no loss of

these animals. We recommend that an observer be on board dredging vessels during the warmer months (April 1 - November 30) and all monitoring results coordinated with our department.

RESPONSE: Trained turtle observers will monitor all dredging activities during the period April 1 - November 30.

South Carolina Department of Parks, Recreation and Tourism

COMNENT (1): Page 21-4.2.6 Entitled Threatened and Endangered Species - It is not clear if the Fish and Wildlife species list is the National list or the South Carolina list. As you know, some species listed in the National list as threatened are listed as endangered on the South Carolina list. Also a legend as to the "status" column's abbreviations would help clarify the lists of the Fish and Wildlife Service and the National Marine Fisheries Service.

RESPONSE: The suggested changes cave been made in the final EIS.

COMMENT (2): Page 1, 8, 10, 14 and 15 make reference to the National Geodetic Vertical Datum, NGVD, assumed to be 1929 datum while pages 16 and 30 references Mean Low Water Datum and while page 19 references Mean Sea Level. Referencing three different data can be confusing; and with only the study's information, it is impossible to accurately convert between the datum. Since there is a small numerical difference between NGVD and Mean Sea Level and au even bigger difference between NGVD, Mean Sea Level, and Mean Low Water, I would recommend the study be on a single datum. You might even find it to be more advantageous to convert to the North America Datum (NAD) 1988 depending on your past data and future accuracy requirements.

RESPONSE: Concur that only one horizontal datum (NAD 84) and one vertical datum (NGVD 29) should be used. Corrected in text.

South Carolina Department of Highways and Public Transportation

COMMENT (1): If upland borrow sites are used (pp 11-12), they could impact future projects Conway Bypass and/or Carolina Bays Parking.

RESPONSE: This project will not use upland borrow sites.

South Carolina Department of Health & Environmental Control

COMMENT (1): SCDHEC must issue water quality certification pursuant to Section 401 of the Federal Clean Water Act. Certification will be issued if the work will not violate State water quality standards.

RESPONSE: This work is in compliance with section 401 of the Federal Clean Water Act (FCWA) and will not violate state water quality standards. NOTE: A section 401, FCWA certification was issued on November 19, 1992.

Federal

United States Environmental Protection Agency

COMMENT (1): EPA remains equivocal regarding the issue of pumping sand onto an eroding shoreface. Generally, we have not had significant opposition to beach nourishment when it provides a disposal site for a proximate, already authorized navigation project. However, the key factor in our concurrence was whether or not biologically sensitive resources would be adversely affected through the use of this disposal method. If this particular case the value of tae threatened structures, declining width of the recreational beach, and the perceived need to provide continued economic potential to shorefront property owners serve as the rationale for beach nourishment.

RESPONSE: No response required.

COMMENT (2): The purpose and needs statement notes that these societal factors subsume the minor environmental losses resulting from the proposed beach fill. The basis for the characterization of minor losses is the observation that the surf zone is inherently unstable. We acknowledge that the surf zone places pronounced stresses on the biota which reside there; however, these organisms are evolutionarily attuned to these perturbations and their natural seasonal rhythms. The

magnitude of the activities associated with renourishment transcends all but the most catastrophic natural processes. Moreover, the necessity of subsequent renourishment due to continuing erosion means that the periods of natural equilibrium can be short.

RESPONSE: No response required.

COMMENT (3): We have some concerns about this proposal from a cumulative standpoint. We would like to know how many other coastal areas of the Charleston District are experiencing similar erosion and/or other marine processes which will require nourishment activities to protect development immediately adjacent to the ocean. The cost potential, environmental and otherwise, of providing similar protection to these areas needs to be factored into federal agency planning as a total package rather than as increments.

RESPONSE: Other South Carolina coastal areas which are experiencing erosion include (but are not limited to) Folly Beach, Edisto Beach, Hilton Head, and Hunting Island. Folly Beach is currently under initial construction. Cost potential, environmental and otherwise, for the Folly Beach Project was included in that Project's General Design Memorandum (GDM) dated May 1991 (REVISRD). At your request, copies of this GDM will be furnished to your office. As of this date, Edisto Beach, Hilton Head, and Hunting Island either do not qualify for Federal assistance or have declined to be non-Federal sponsors for nourishment projects. Although planning as a total package rather than as increments may be the preferred alternative, each project has to be studied and justified individually. Several beaches along the South Carolina coast such as Hilton Head, Hunting Island, Seabrook Island, Pawley’s Island, Litchfield Beach, Garden City, Myrtle Beach, and North Myrtle Bench have been privately nourished in the past with minimal environmental effects.

COMMENT (4): An unstated problem at Myrtle Beach is the election of home owners, businessmen, etc., in conformance with the current zoning regulations to intensify development in this attractive, but high risk area. Given the amenities associated with living on the shoreline, this may be understandable. Nonetheless, Corps of Engineers' publications have bell documented that these coastal areas are dynamic features experiencing almost daily fluctuations due to marine processes.

RESPONSE: Acknowledged. No response required.

COMMENT (5): An examination of the papers - "Saving the American Beach" (results of the Skidaway Institute of Oceanography Conference of America's Eroding Shoreline, March 25-27, 1981), "Greenhouse Effect and Sea Level Rise - A Challenge for This Generation," edited by Michael Barth and James Titus, or "The Beaches are Moving" by Wallace Kaufman und Orrin Pilkey, have been helpful in our understanding of the long-term overall public interest in these kinds of projects. Quite simply, given the comprehensive nature of the problem and the magnitude of the forces involved, we are uncertain that maintenance of an increasing number of these nourishment projects is feasible.

RESPONSE: Periodic nourishment and maintenance have been factored into the economic analysis of this project and has shown a benefit/cost ratio of better than 1:1. We believe that we can physically and economically maintain beach projects as have beep demonstrated with past beach nourishment projects.

COMMENT (6): All of the above notwithstanding us are sensitive to the economic and societal benefits accruing from individual beach nourishment projects. However, the local sponsors should be made aware of the possibility that ultimate economic losses could actually be greater due to continued intensification of land use predicated in large measure on the assumption that a beach will always be present in front of the property. These observations may not prove especially compelling to the local sponsors right now, but he would be remiss not to indicate that the technical insight/understanding on the long-term effectiveness of beach nourishment has been called into doubt by some coastal geologists.

RESPONSE: The local sponsors are well aware of short-term and long-term economic responsibilities.

COMMENT (7): In this regard, an important point to emphasize is that "short-term" protection is all that is being offered. At the end of the project life it is conjectural whether the present erosion situation will be any different. The EIS did not indicate whether the exact cause of the beach losses is known. At some point a study to determine the causal reason for this erosion should be considered in an attempt to see if a more lasting solution is available. While not seriously considered, the nonstructural alternative of building relocation may provide the only long-term solution to the situation. The nourishment proposal may merely postpone the

inevitable. In the light of recent decisions to restructure federal funding as well as changes in the cost sharing mechanisms, subsequent evaluations should factor in the possibility that the local sponsor may have to increase its' financial commitment over the projected life of the project.

RESPONSE: Beaches along the South Atlantic coast have historically eroded and accreted along varying reaches. No attempt to determine the causal reason for erosion along the Grand Strand was attempted due in part to the magnitude of the project and the general assumption that the gradual sea level rise will cause continued beach erosions. The local sponsors are aware of the financial responsibilities for maintaining a usable beach and rave weighed these responsibilities against benefits.

COMMENT (8): The ultimate use of the selected borrows sites (Surfside and Cane North and South) should be examined in the following contexts: long-term effect on the sand budget of the adjacent shoreline, compatibility of the borrow material with native beach material, and their percentage of fines. The shoreline of these beach sites is currently degrading. If the material from the borrow site is moved directly onto the shoreface, how will this affect future onshore sediment movement via natural incremental processes? We are concerned that the present instability may be exacerbated and/or the maintenance frequency may have to be shortened. The possibilities associated with what is effectively a mining action should be determined now rather than after the fact.

RESPONSE: The borrow sites are designated to be approximately 1.5 to 5 miles offshore beyond the depth of closure. Therefore, future onshore sediment movement via natural incremental processes will not be affected.

COMMENT (9): We assume that the computer model DUNE or an analog was used to evaluate this project. We are interested in the results of this modeling since one of its basic components in determining storm reduction benefits predicates that the amount of material eroded must equal the amount deposited. If the offshore area has been mined of material, then it would appear that the model results would be influenced. The extent of the "influence" should be determined during this planning phase.

RESPONSE: The DUNE computer model was used to develop cross-shore movement during storm events. The movement of

material was within the near shore area (less than 1500 feet from the shoreline). Since the borrow sites are 3 to 5 miles offshore, these borrow sites had no influence on the model results.

DOMMENT (10): A large number of vibracore samples were taken throughout the borrow area. A comparison of the textural classes of this borrow sand had already been made with the current material on the subject beaches. However, since the native beach has been modified by the addition of sand from various other sources, compatibility may be more problematic than the text implies. It may be necessary to shorten the frequency of renourishment due to increased erosion in this regard. The consequences, environmental and otherwise, of this possibility should be examined in the final EIS.

RESPONSE: The vibracore borings ware analyzed and the results of this analysis are provided in the Myrtle Beach Storm Reduction Project GDM. Ad your request, this GDM will be provided to your office.

COMMENT (11): Additionally, these cores should be examined to determine the percentage of fines in the proposed fill. It has been our experience that even a small percentage of silt and clay fractions in beach fill can lead to long-term turbidity problems at a re-nourished beach. The percentage of fines and dissimilar fill material determine the degree to which the beach will be "over bulked" to factor in losses due to wave action.

RESPONSE: The District office concurs that compatibility may by very difficult to predict because the native beach has been modified by the addition of sand from various other sources. However, overfill factors were determined using the Adjusted Shore Protection Manual Technique. James' curves (from James, 1975), showing iso-lines of adjusted overfill factors for values of phi mean difference and phi sorting rations were utilized. By using James' curves, a graphical determination of associated overfill factors was made. Also, the District excluded areas within the borrow sites which had fines exceeding 25 percent of the core sample. Fines were defined as material which would not be retained on a standard sieve size of 200. At the time of final design, additional core samples will be collected and used to determine the exact area which will be used during initial construction. One of the borrow site selection factors will be material compatibility. The analysis of the borrow sites and native

beach at Myrtle Beach and vicinity comprise a major portion of that project's GDM. At your request, copies of this finalized GDM will be provided to your office.

COMMENT (12): The storm damage model together with its component elements used for this project should be discussed. We are particularly interested in the assumptions used in the development of an estimate of annual storm damages compared to different scenarios of sea level rise. We would like to be able to determine how the potential for an increase in the present rate of sea level rise would influence this project. If an accelerated rise does prove to be the case, the details of the impact(s) should be assessed.

RESPONSE: The impact on sea level rise was not included in the economic analysis. A figure for sea level rise was computed for the GDM on an annual basis and is included in the General Engineering Design and Cost Estimates (Appendix 1 of the GDM). The sea level rise projected would amount to less than half a foot over the life pf the project and was not considered to have a significant impact on the amount of future periodic nourishment that would be required to maintain the designed project.

COMMENT (13): Since this is a reformulation, the benefits generated by project construction were not stated. It has been our experience that they are usually a significant subset of the total value of threatened beach front property. The final EIS would be improved if the components of the latter figure were presented. More precisely, how much of this total value figure is a function of the housing value, per se, and how much has to do with its location immediately adjacent to the shoreline? This information is very important since the second element is immediately affected by the degree of shoreline stability. In this particular case the shoreline is degrading; therefore, just how this property should be valued is important. In the absence of a federal interest to continue with this nourishment project and/or the ability/willingness of the homeowners to protect this property, its' long-term value would be lessened. This would greatly affect the economics of the project and more importantly its purpose and need. This potential should also be examined in the final EIS.

RESPONSE: A detailed analysis of the economics associated with the proposed project is included in the General Design Memorandum (GDM) (Appendix 2). The value of land was not included in the analysis. The benefits were derived using the

value of the structures and associated improvements. The value associated with the location was not included. Copies of the GDM will be provided to your office.

COMMENT (14): Moreover, for the without project condition is it reasonably to assume that this property would be maintained for more than a few years let alone the 50-year life of the project? This, in fact, is the underlying premise of the without project comparison. Rather, it seems much more likely that the annual loss value would just accumulate as no repairs were accomplished. The figure would rapidly approach the total value of the beach front dwellings and then as rapidly decline after they were no longer habitable. Of course, the value of the adjoining, landward property would probably increase as it became "beach front". We would be interested to learn if there are any data which would support the premise that in the absence and/or anticipation of a federally subsidized nourishment project what homeowners will sustain the losses assumed by the Corps of the Engineer’s models. The most interesting factor associated with this overall benefits comparison is the probability that the costs of the nourishment project over its 50-year life span subsume the real value of threatened property.

RESPONSE: Again the value of the land was not included in the analysis. Field investigations after Hurricane Hugo along Myrtle Beach and other barrier islands along the coast show that not only do the land owners maintain their structures, but where they are completely removed the structures are replaced with higher valued structures. In the analysis a conservative assumption was made that the analysis would only consider the replacement and maintenance of the existing structures and would not consider any future development. The analysis also included that replacement property would be constructed in accordance with Federal Flood Insurance Regulations.

COMMFNT (15): This is a reformulation of an existing authorized project; therefore, we assume that public access to each of the three segments meets Corps' requirements. Nonetheless, we would like to be reassured in the final EIS that assess and adequate parking is available to more than just the owners of the shoreline property.

RESPONSE: The issue of public access is addressed in the GDM, and the non-Federal sponsor will be required to maintain access in accordance with Corps regulations.

United States Department of the Interior

COMMENT (1): The coast of South Carolina is noted for its exceptional deposits of heavy sands that comprise the greatest resource of that material in the United States. Material found in the sands includes the minerals ilmenite, rutile, zircon, and monazite from which can be obtained the elements titanium, zirconium, thorium, cesium, lanthium, and rare earth elements. The heavy sands are not being mined in South Carolina now because material can be imported cheaper than it can be mined in the United States. Still, in a time of national emergency, the deposits in South Carolina could become critical. The richest deposits are toward the southern end of the state. Exploration has shown the heavy sands in the area of this project are of low grade compared with the deposits further south and likely would not be mined. Because of the national importance of these deposits, however, the document should include a discussion of the heavy sand resources and explain why this particular project would have no significant impact upon them.

RESPONSE: Construction of this project would not diminish the quantity or quality of heavy sand resources obtainable along portions of the South Carolina coast. During a time of National Emergency any sand used in the construction of this project, which proved to be unique or unattainable from other sources, would be conveniently available on the beach at the Grand Strand.

United States Department of Commerce (NOAA)

COMMENT (1): The description of hard and live bottom habitat found in the project area is confusing. Sufficient detail is not presented do assess project impacts on the near shore environment in connection with placement of sediment for beach nourishment. The DEIS also does not adequately describe impacts that may occur in the vicinity of the offshore borrow sites.

RESPONSE: A description of near shore hard and live bottom habitat occurrence has been clarified in the EIS. In general, patchy areas of near shore hard and live bottom habitat in the project area was identified by Van Dolah and Knott in 1984 in a

report entitled A Biological Assessment of Beach and Near shore Areas along the South Carolina Grand Strand. The bulk of the hard bottom habitat is located in the Myrtle Beach reach. The scattered areas of hard bottom areas located in water 5.5 NGVD or less is subject to direct fill by sand. A monitoring plan is being developed with the S.C. Wildlife and Marine Resources Department (SCWMRD) to assess the secondary impacts of sand movement on near shore hard bottom areas in water depths greater than 5.5 NGVD.

Io regard to offshore borrow site impacts, a considerable amount of effort was concentrated in locating sand offshore sites which are free from hard and live bottom areas. Sides can sonar and video camera transects were employed via contract with SCWMRD in assessing potential borrow sites. Areas of hard and live bottom habitat were identified, plotted on contract maps, and will be avoided during borrow activities. Numerous studies from neighboring states of offshore borrow site impacts have shown only short-term impacts to macro infaunfa communities. A similar monitoring study will be conducted on offshore borrow site impacts for the Myrtle Beach project.

COMMENT (2): The DEIS also fails to adequately address the cumulative impact of this type of activity on living marine resources. We are concerned that habitat alteration associated with this and numerous similar projects along the South Carolina coast will result in a reduction of forage species such as macro invertebrates and, subsequently, harvestable fish that rely on these organisms. In the absence of this information, we find no basis for the determination that the proposed action will have "no serious impact on fisheries".

RESPONSE: Numerous studies of beech nourishment projects and offshore borrow sites along the South Atlantic coast have shown impacts to be short-term, with rapid recovery of macro invertebrate forage species. Based on the demonstrated rapid recovery of macro invertebrates and the fact that the Myrtle Beach project will be re-nourished in three segments over a multi-year period, the project will have no significant impact on fisheries. The District is cooperating with SCWMRD in developing a biological monitoring plan to assess recovery of macro invertebrates in at least one of the three nourishment reaches.

COMMENT (3): Page 3, paragraph 2. The total project length should be clarified. The project length given on Page 1

is 22.6 miles. Page 11, paragraph 1, specifies 25.7 miles and page 30, paragraph 4 specifies 23.9 miles.

RESPONSE: The project length on page 1 refers to the authorized project in the 1998 Water Resources Development Act. The total project length described on page 30 refers to an alternative beach nourishment consideration. The project length on page 30 was considered accurate at the time the Draft EIS was printed. However recent calculations indicate the project will be approximately 25.4 miles total. The corrected calculation has been included in the final EIS.

COMMENT (4): Page 9, paragraph 1. We disagree with the statement that beach nourishment would "benefit a variety of invertebrates, birds, and fish." The likely "best case" scenario is one in which the adverse impacts would be of short duration and existing animal populations quickly return to predisposal levels. Consequently, documentation of any anticipated benefits to living marine resources, as referenced in the DEIS, is needed.

RESPONSE: This project will create approximately 600 acres of high tide and intertidal beach where none now exists. It is reasonable to assume that a variety of species would benefit from this additional beach area over the life of the project. Birds enjoy a primary benefit from the renourishment operation as can be witnessed by any one visiting a nourishment operation. The intertidal beach would provide additional habitat for invertebrate species and subsequently fish forage.

COMMENT (5): Page 3, paragraph 2. We disagree with the determination that the loss of organisms at the offshore borrow sites and on the intertidal beach are "insignificant." The ecological roles on these habitats and their associated fauna are not described, but may be significant with regard to the survival and abundance of resident and migratory species such as spot, summer flounder, bluefish, whiting, Florida pompano, and others. Although the magnitude of impact associated with dredging and dredged material disposal in these habitats varies seasonally, the significance of this relationship is not discussed. The importance and need for seasonal work restrictions should be addressed, particularly with regard to benthic and epibenthic population recovery.

RESPONSE: We agree that the ecological roles of the intertidal beach and offshore borrow sites are ecologically important. However, numerous scientific monitoring studies of

similar beach nourishment projects throughout the South Atlantic region has demonstrated that the recovery of macro invertebrate forage species from both intertidal and offshore borrow sites is rapid. Seasonal variation of faunal diversity is well documented in the literature. The magnitude of the Myrtle Beach project requires construction throughout all seasons of the year; therefore seasonal dredging restrictions were not optional for this project.

COMMENT (6): The DEIS states that a monitoring plan is being developed to assess project related impacts on the intertidal disposal and offshore borrow site benthos; however, monitoring of project's impacts on finfish is not included. Information on the impacts of beach nourishment on finfish is needed, especially with regard to the effects of periodic elimination of near shore forage species such as mole crabs (Emerita talpoida) and donax (Donax spp.). Therefore, we recommend that fish monitoring, including effects on feeding and forage species abundance, be performed and that the NMFS be consulted in connection with development of the monitoring plan. Additionally, other project related effects such as increased turbidity levels and changes in substrate composition should be addressed with respect to possible impacts on fishery resources.

RESPONSE: As stated earlier, a monitoring plan is being developed in cooperation with SCWMRD to assess project related impacts on benthos on the intertidal, sub-tidal and offshore borrow sites. Monitoring of lower life benthos is considered a more accurate indicator of project impacts in lieu of monitoring the more motile finfish. Van Dolah, et al. 1992, suggested from the diet analysis of finfish studied in the offshore borrow sites for the Hilton Head nourishment project that most finfish would not be directly affected by the loss of benthic fauna in the borrow areas. A copy of the monitoring plan will be forwarded to NMFS for review and comment.

COMMENT (7): Page 14, paragraph 1, line 4. Much of the area within 5,000 feet of the shore is "hard bottom." However, it is unclear how this term is used and whether it is synonymous with the biological description of "live bottom." If extensive live bottom habitat is located within 5,000 feet of shore, and significant offshore migration of sand could adversely impact this important habitat. Accordingly, the DEIS should address the impact of beach nourishment and possible movement of sand onto live bottom areas.

RESPONSE: The EIS has been reviewed to clarify the term. Refer to Response No. 1 and discussion of hard and live bottom resources and a proposed monitoring plan.

COMMENT (8): Page 21, paragraph 3. No information is provided in this section regarding the size, frequency, and distribution of "hard bottom" habitat in the project area. Although a bottom survey of the project area was performed, we are concerned that the small size of some live bottom areas may have resulted in an underestimation of the occurrence of hard and live bottom habitats in the project area. More detail needs to be provided regarding the techniques used to assess the occurrence of hard and live bottom habitat in the project area.

RESPONSE: The hard and live bottom survey report for the offshore borrow sites is too bulky to be added as an appendix. However, these reports are available upon request addressed to the Charleston District.

COMMENT (9): Page 31, paragraph 2, line 8. The basis for the determination that recovery would occur in three-to-six months should be provided. This section also does not address the cumulative impact on fisheries of depositing sand on about 24 miles of beach. Assuming that a 200-foot-wide fill zone is created (no cross sectional drawings were provided), approximately 581.8 acres of intertidal/nearshore habitat would be altered. In this regard, the effects of periodic maintenance work, occurring at eight year intervals, should also be described.

RESPONSE: The three-to-six months determination is based on Reference 5 page 38, of the DEIS and on personal communication with Dr. Robert Van Dolah (SCWMRD). This project will be constructed in three phases. Recovery of resources in one phase is expected to be complete before construction of another begins. Any one of these phases is not expected to have a significant cumulative impact on fisheries especially in view of the overall quantity of similar habitat along the South Carolina coast. A detailed plan with cross section drawings, etc. is available in the project General Design Memorandum (GDM). This GDM is available upon request addressed to the Charleston District. The effects of maintenance work will be essentially the same as the initial construction.

COMMENT (10): Page 32, paragraph 1, line 2. See our previous comments on the need for additional information on

live bottom survey techniques. To our knowledge, the study referenced in this section has not been provided for our review. In view of the importance of this information, we request that the report be included as an appendix to the DEIS.

RESPONSE: The live bottom surveys are bulky and cannot be conveniently attached as an appendix and mailed. However these survey reports are available upon request addressed to the Charleston District.

COMMENT (11): Page 34, paragraph 2. We disagree with the determination that "This project will have no serious impact on marine fisheries." Studies of beach nourishment in South Carolina are limited and none of the studies performed to date have examined impacts on fish. In addition, no consideration was given to the seasonal nature of potential impacts of dredging and dredged material disposal, or to the potential cumulative impact of nourishing approximately 24 miles of shoreline. Accordingly, we believe that the conclusion of "no serious impact" in the DEIS is premature and should be reassesses.

RESPONSE: The District is aware of limited data available on the impact of offshore borrow on fishery resources. However, many studies have been conducted on impacts of the same on benthos and the literature indicates minor impacts with quick recovery. Fish are not expected to be affected by the dredge but they may be secondarily affected by temporary disruption to the life cycle of benthos caused by dredging. The cumulative impact of this project is not expected to be significant in view of the three phased approach to construction and quick recovery of benthos. Consideration was not given to the seasonal nature of the impacts of this project because the project is not to be constructed on a seasonal basis. A thorough plan is being developed to monitor the physical and biological impacts of this beach nourishment project. This monitoring plan will be designed to distinguish natural seasonal damages in community structure from changes attributable to nourishment activities.

COMMENT (12): Page 33, paragraph 1. It is not clear if consultation with the NMFS, as required under Section 7 of the Endangered Species Act, was conducted. The DEIS should address status and results of such consultation.

RESPONSE: Consultation either the NMFS, as required under Section 7 of the Endangered Species Act was conducted. A list

of species for which the NMFS is responsible was requested September 11, 1991 (page 22 of the DEIS). A biological assessment was prepared for this list with a "no effect" finding. An "effect" finding for nesting sea turtles was further coordinated with the U.S. Fish & Wildlife Service.

10. List of Preparers

Jim Woody, Biologist
U.S. Army Corps of Engineers
Charleston District
15 years employed by Corps of Engineers

Millard Dowd, Coastal Engineer
U.S. Army Corps of Engineers
Charleston District
22 years employed by Corps of Engineers

Russell Jackson, Economist
U.S. Army Corps of Engineers
Charleston District
6 months employed by Corps of Engineers

Ursula Smalls, Student Trainee Engineer
U.S. Army Corps of Engineers
Charleston District
3 years employed by Corps of Engineers

11.0 Distribution List

Honorable Strom Thurmond, U.S. Senator
Honorable Ernest F. Hollings, U.S. Senator
Honorable Robert M. Tallon, U.S. Representative
Honorable A. Ravenel, Jr., S.C. State Senator
Honorable J. J. Snow, Jr., S.C. State Representative
Honorable R. L. Altman, S.C. State Representative
Honorable D. L. Hinds, S.C. State Senator
Honorable F. Gilbert, S.C. State Senator
Honorable J. Y. McGill, S.Y. State Senator
Honorable J. M. Long, S.C. State Senator
Honorable D. Elliott, S.A. State Representative
Honorable K. B. Corbett, S.C. State Representative
Honorable T. G. Keegan, S.C. State Representative
Honorable L. M. Martin, S.C. State Representative

Honorable Carroll A. Campbell, S.C. State Representative
U. S. Geological Survey
Advisory Council on Historic Preservation
Agriculture Stabilization & Conservation Service
U. S. Forest Service
Soil Conservation Service
U. S. Department op Energy
U. S. Environmental Protection Agency
Federal Emergency Management Administration
Federal Maritime Commission
U. S. Department of Health and Human Services
U. S. Department of Housing and Urban Development
U. X. Department of Interior
U. S. Coast Guard
Federal Highway Administration
U. S. Department of Commerce
S. C. State Clearinghouse
S. C. Sierra Club
S. C. Wildlife Federation
S. C. Wildlife Society
S. C. Coastal Conservation League
S. D. League of Women Voters
S. C. Nature Conservancy
National Audubon Society
City of Myrtle Beach
Town of Surfside
Town of Garden City Beach
City of North Myrtle Beach
Horry County Planking Department

Mailing list of individuals receiving copies of the DEOS is available upon request.

12.0Refprences

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8 Dolan, Robert; Fucella, Joseph; Donohue, Cinde - July 1992. Final Report Monitoring and Analysis of Beach Nourishment Placed on Pea Island, North Carolina, Alligator National Wildlife Refuge 1091-1992.

9 Reilly, Jr., Francis J. and Bellis, Vincent J., March 1983. Miscellaneous Report No. 83-3, The Ecological Impact of Beach Nourishment with Dredged Materials on the Intertidal Zone at Bogue Banks, North Carolina. U S Army Corps of Engineers, Coastal Engineering Research Center.

13.0 Index

14.0 Tables

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2. Map of Project Including Offshore Borrow Sites

17.0 Appendix 1
Letters of Comment